Transitioning the North American Land Data Assimilation System (NLDAS) into NCEP Operations

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NCEP/Climate Prediction Center

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Eric Luebehusen, USDA

Outline

- **Motivation**
- **NLDAS Overview**
- **Background**
- **Components**
- **Products**
- **Future**

Motivation: Hydrometeorological Extremes: Drought

Meteorological: Precipitation

Agricultural: Soil moisture

Hydrological: Streamflow

Drought

From Wikipedia, the free encyclopedia

For other uses, see Drought (disambiguation).

Drought is an extended period when a region receives a deficiency in its water supply, whether atmospheric, surface or ground water. A drought can last for months or years, or may be declared after as few as 15 days.[1] Generally, this occurs when a region receives consistently below average precipitation. It can have a substantial impact on the ecosystem and agriculture of the affected region. Although droughts can persist for several years, even a short, intense drought can cause significant damage[2] and harm to the local economy.[3] Prolonged droughts have caused mass migrations and humanitarian crises.

Motivation: Hydrometeorological Extremes: Flood

2013 Colorado Flooding

Flash Flood

Flood

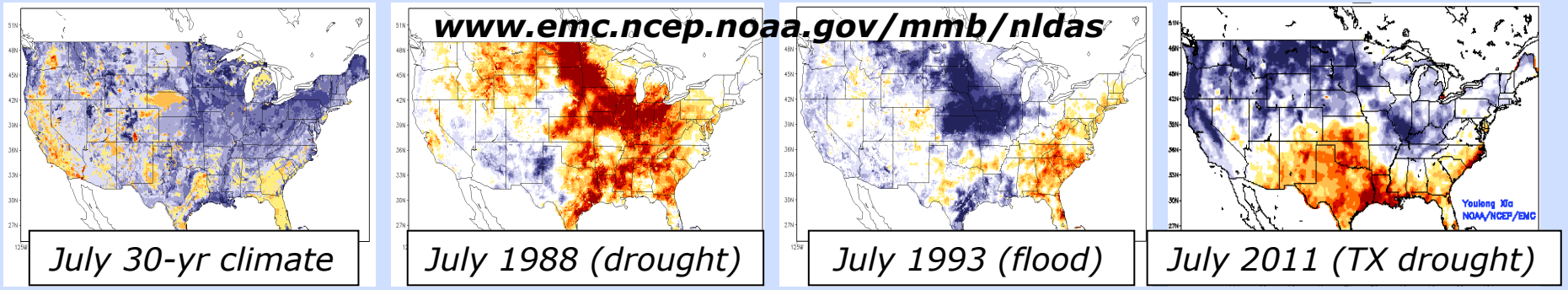
From Wikipedia, the free encyclopedia

For other uses, see Flood (disambiguation).

A **flood** is an overflow of water that submerges land which is usually dry.[1] The European Union (EU) Floods Directive defines a flood as a covering by water of land not normally covered by water.[2] In the sense of "flowing water", the word may also be applied to the inflow of the tide. Flooding may occur as an overflow of water from water bodies, such as a river or lake, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries,[3] or it may occur due to an accumulation of rainwater on saturated ground in an areal flood. While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, these changes in size are unlikely to be considered significant unless they flood property or drown domestic animals.

Overview: North American Land Data Assimilation System (NLDAS)

- Land models: Noah, SAC, VIC, Mosaic run in "uncoupled" mode.
- Forcing: NCEP Climate Prediction Center obs precip (gauge-based, radar/satellite disaggregatred), and atmospheric forcing from NCEP North American *Regional Climate Data Assimilation System.* Output: 1/8-deg. land & soil states, surface fluxes, runoff/streamflow.
- Climatology from land model assimilation runs for 30+ years provide **anomalies** used for **drought monitoring**; supports USDM, NIDIS etc.
- ***Operational at NCEP 05 Aug 2014.***
- Research supported by NOAA Climate Program Office for NLDAS partners: NASA/GSFC, NWS Office of Hydro. Develop., Princeton Univ., Univ. Washington.



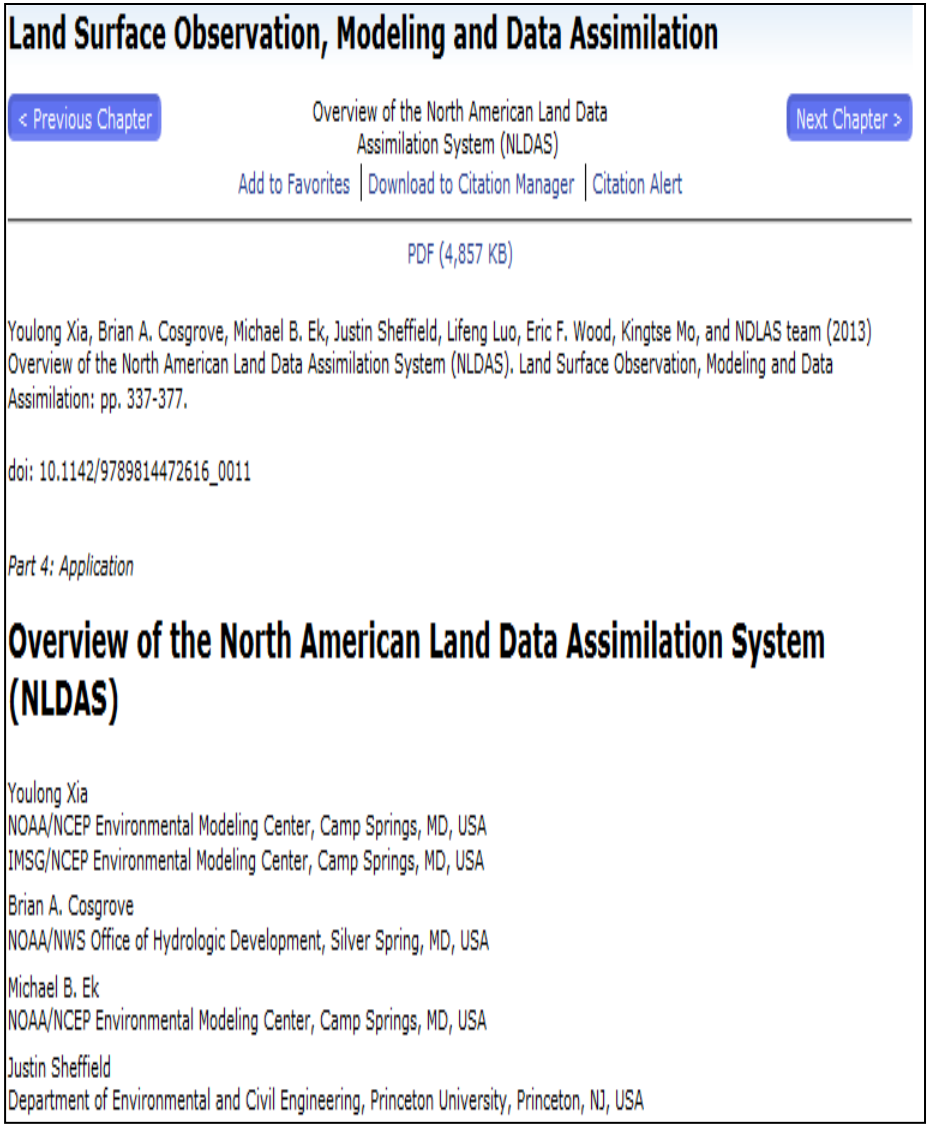
NLDAS four-model ensemble monthly soil moisture anomaly

NLDAS Background: *Partners*

- **NLDAS, Data Sets, Land Model Development:**
  M. Ek, Y. Xia, H.Wei, J. Dong, J. Meng (NCEP/EMC)
  J. Sheffield, E. Wood et al (Princeton U.)
  D. Mocko, C. Peters-Lidard (NASA/GSFC)
  V. Koren, B. Cosgrove (NWS/OHD)
  D. Lettenmaier et al (U. Washington)
  L. Luo (U. Michigan, formerly Princeton)
  Z.-L. Yang et al (UT-Austin); F. Chen et al (NCAR), etc.
- **NLDAS Maintenance and Operational Transition:**
  Y. Xia (NCEP/EMC land group), Yuqiu Zhu (NCEP/EMC), Simon Hsiao and others (NCO)
- **NLDAS Products Application:**
  K. Mo (NCEP/CPC)
  M. Rosencrans (CPC), Eric Luebehusen (USDA), U.S. Drought Monitor (USDM) Author Group, and National Integrated Drought Information System (NIDIS).
- **Support:**
  NOAA Climate Program Office: MAPP (currently) and previous programs

NLDAS Background: History

- Multi-agency/institute collaboration.
- Long-term Research effort (pre-2000 to 2014).
- Multi-grant support: NOAA Office of Global Programs, Climate Program Office, under GCIP, GAPP, CPPA, and MAPP projects, and NASA/ Terrestrial Hydro Program
- Supported Research-to-Operation work (R2O)
- **Connections to Climate Test Bed (CTB), Hydrometeorological Testbed (HMT)**



Land Surface Observation, Modeling and Data Assimilation

< Previous Chapter | Overview of the North American Land Data Assimilation System (NLDAS) | Next Chapter >

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doi: 10.1142/9789814472616_0011

Part 4: Application

Overview of the North American Land Data Assimilation System (NLDAS)

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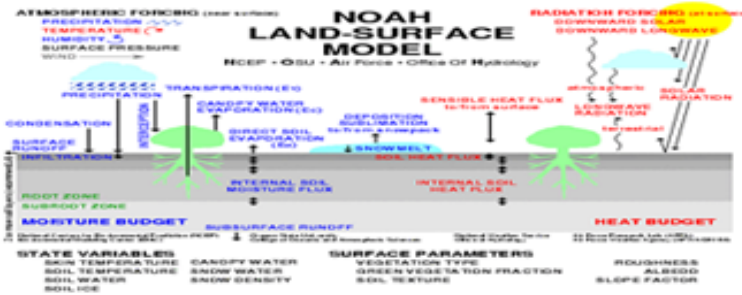
Justin Sheffield
Department of Environmental and Civil Engineering, Princeton University, Princeton, NJ, USA

NLDAS Components: Land Models

Operational Models

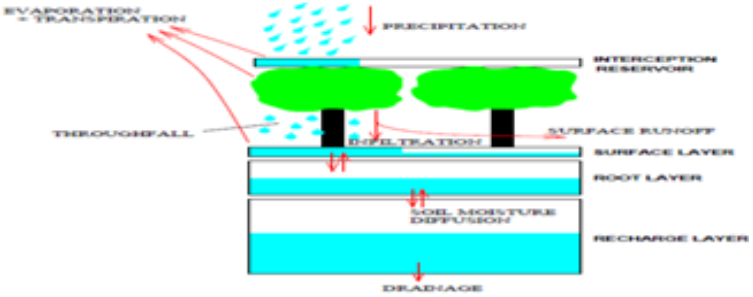
Research Models

Atmospheric Community



Noah

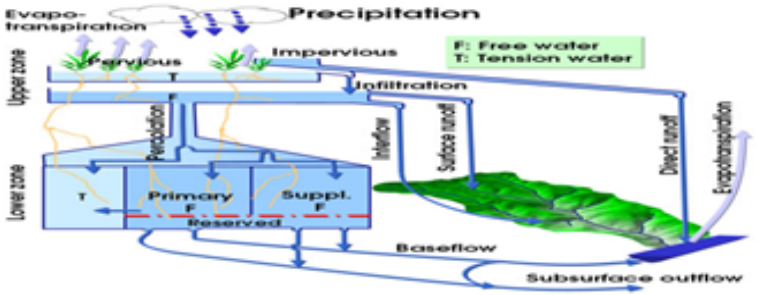
NCEP operational land model



Mosaic

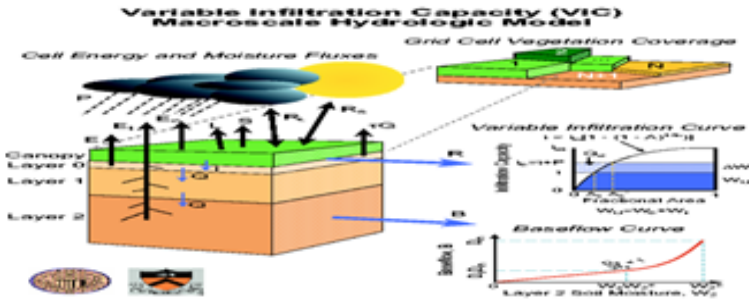
NASA GSFC

Hydrology Community



SAC

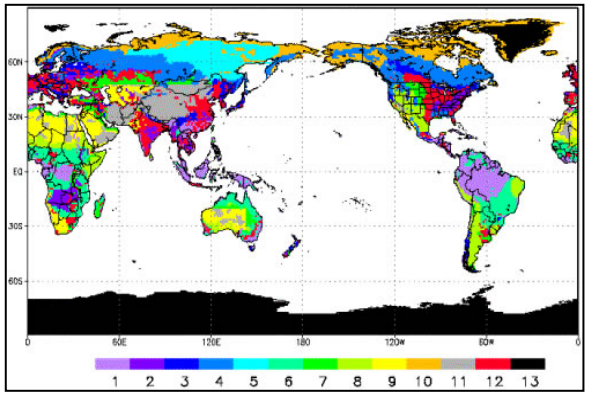
NWS operational hydrological model



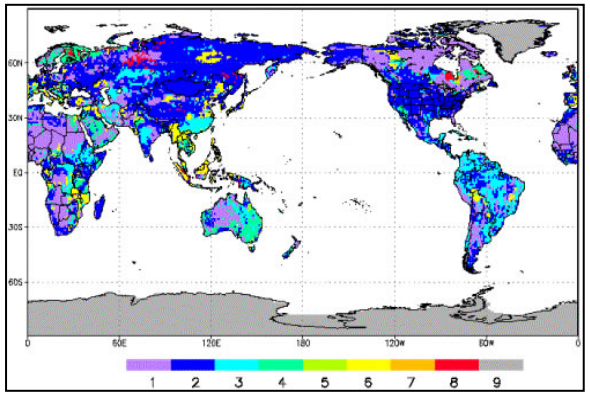
VIC

Princeton & U. Washington

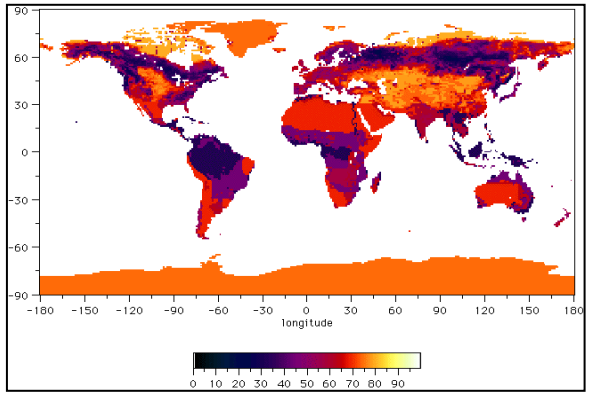
NLDAS Components: Land Data Sets



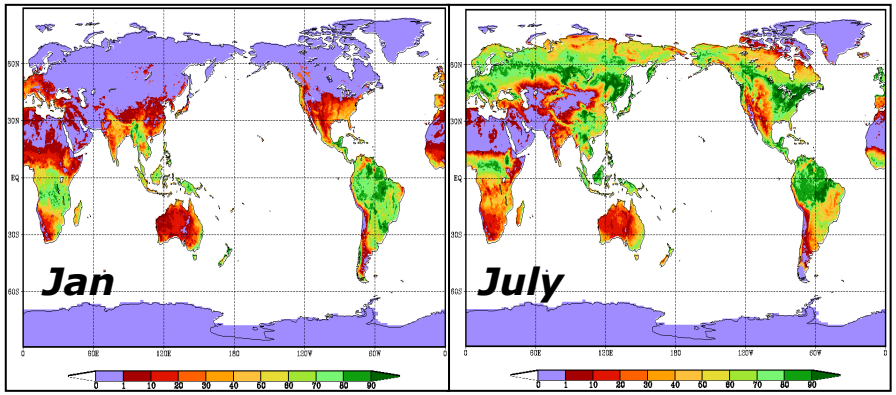
Vegetation Type
(1-deg, UMD)



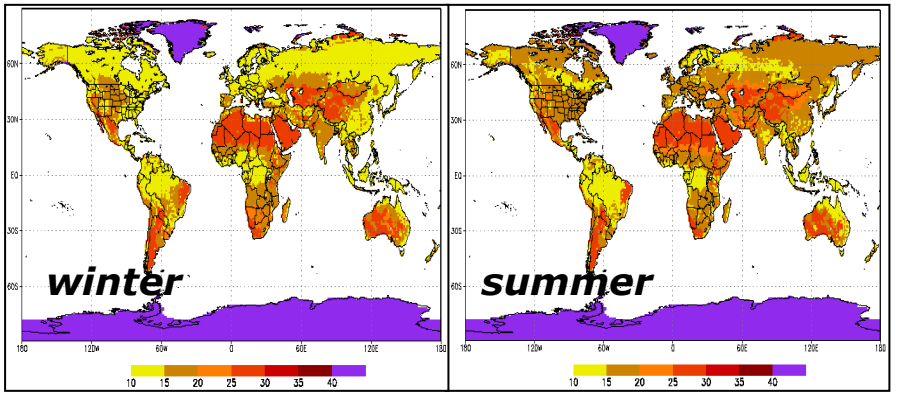
Soil Type
(1-deg, Zobler)



Max.-Snow Albedo
(1-deg, Robinson)



Green Vegetation Fraction (GVF)
(monthly, 1/8-deg, NESDIS/AVHRR)

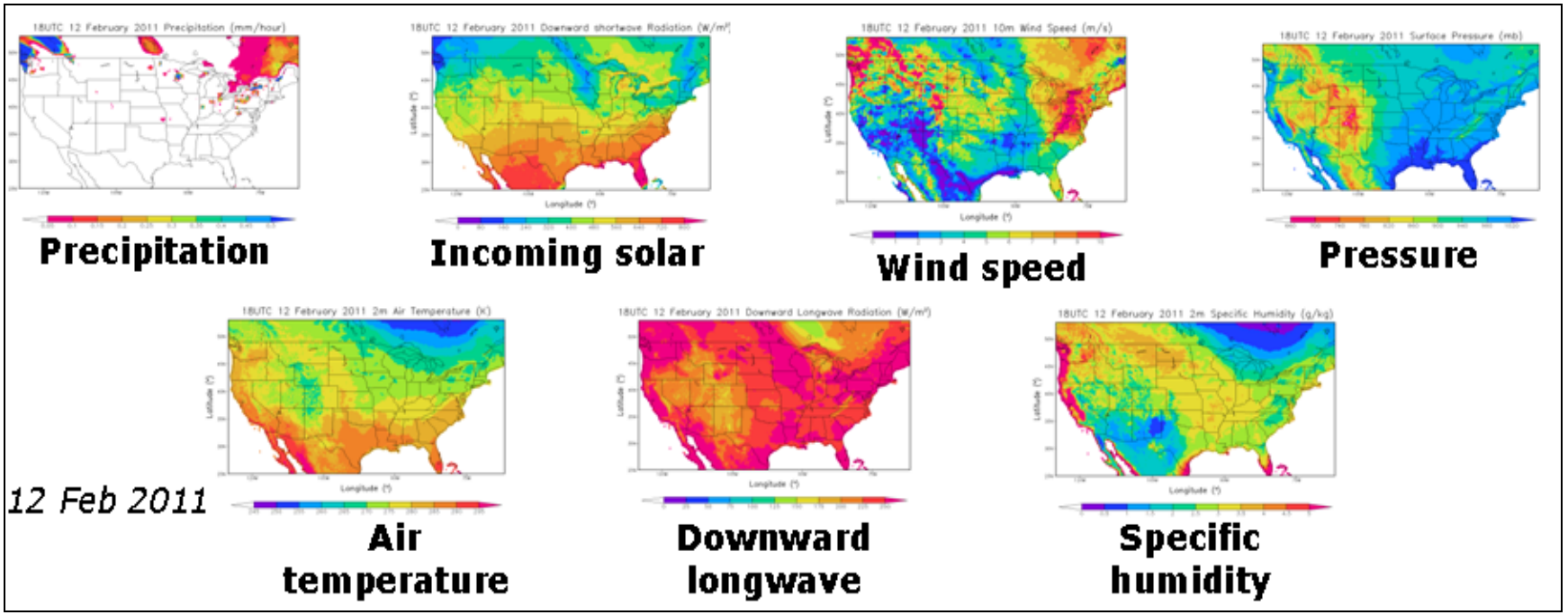


Snow-Free Albedo
(seasonal, 1-deg, Matthews)

- Fixed climatologies, or near real-time observations (e.g. GVF), some quantities to be assimilated (e.g. snow, soil moisture).

NLDAS Components: Atmospheric Forcing

- Common atmospheric forcing from Regional Climate Data Assimilation System (real time extension of the North American Regional Reanalysis, NARR) - backbone.
- CPC gauge-based observed precipitation, temporally disaggregated using radar data (stage IV), satellite data (CMORPH), bias-corrected with PRISM monthly values.
- Bias-corrected NARR solar radiation from GOES retrievals.



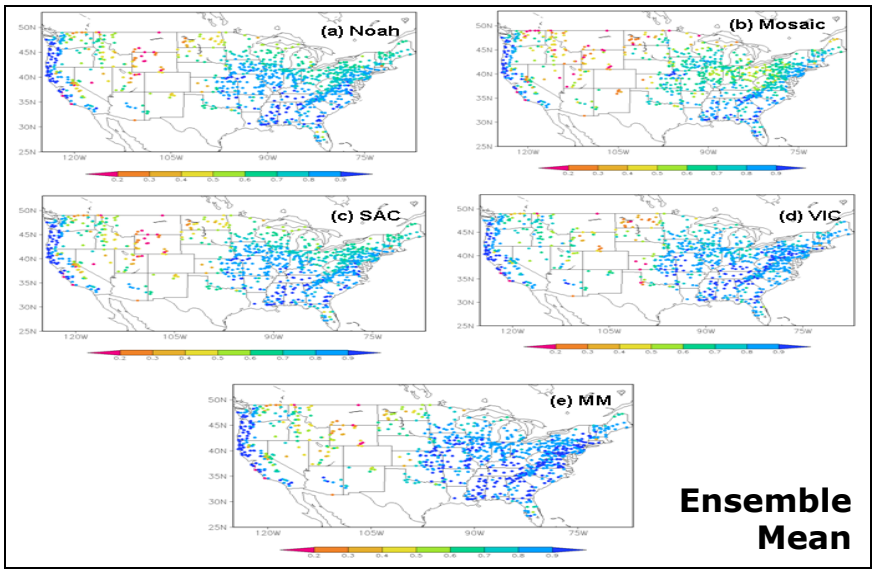
NLDAS Components: Evaluation and Validation

Comprehensive evaluation against *in situ* observations and/or remotely sensed data sets.

Energy flux validation from tower: net radiation, sensible, latent & ground heat fluxes.

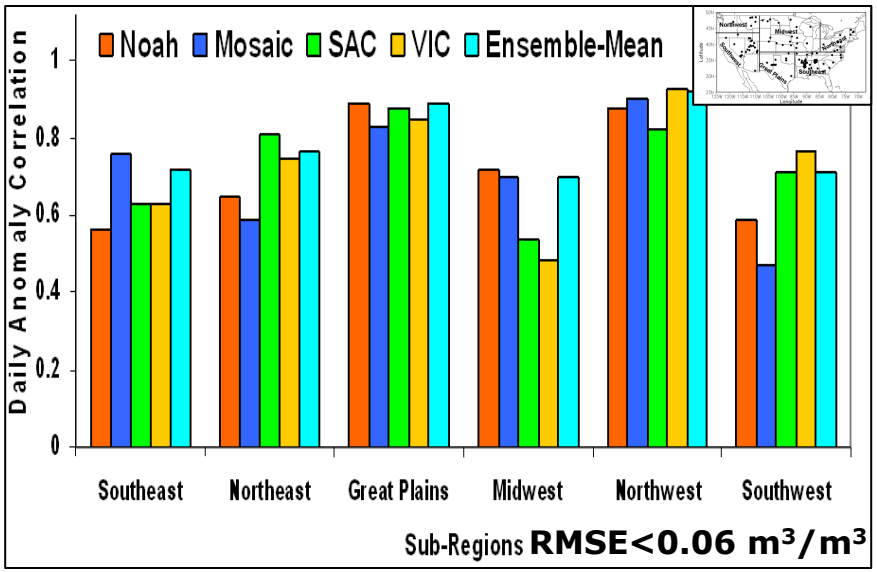
Water budget: evaporation, total runoff/streamflow.

State variables: soil moist., soil/skin temp., snow depth/cover.



Xia et al., JGR-atmosphere, 2012

Monthly streamflow anomaly correlation (1979-2007 USGS measured streamflow)



Xia et al., J. Hydrol., 2014a

Daily top 1m soil moisture anomaly corr. (2002-2009 US SCAN Network)

NLDAS Products: Web Sites

NLDAS Homepage - Mozilla Firefox

GES DISC Home Page — GES ...

daac.gsfc.nasa.gov

Most Visited | Getting Started | about:home | Latest Headlines | https://timesheets.ims... | Customize Links | https://www.google.c...

EARTHDATA | Data Discovery | Data Centers | Community | Science Disciplines

ftp://ftp.ncep.noaa.gov/pub/data/nccf/com/nldas/prod
http://www.ftp.ncep.noaa.gov/data/nccf/com/nldas/prod/
ftp://ldas.ncep.noaa.gov/nldas2/nco_nldas/

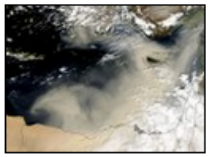
GES
About

You are here: GES DISC Home

NLDAS User Statistics for calendar year 2014:

Number of distinct users: 5,437
Number of files downloaded: 44,119,161 (over 44 million)
Total volume downloaded: 93,459 Gb (over 93Tb)

Brief articles about GES DISC scientific and technical activities



Jul 21, 2014 - Aerosol data from SeaWiFS, 1997-2010, now available in Giovanni-4
Giovanni-4 provides more analysis methods, new visualizations, and faster performance
+ Read More...

Extended articles about topics of interest to the GES DISC user community

May 14, 2014 - April dust storm surges through China from the Taklimakan Desert
2014 dust outbreak moves from the Tibetan Plateau to the Pacific coast
+Read More...

Feb 06, 2014 - Satellite observations of carbon dioxide: Why are they important; and what CO2 data

Jul 15, 2014 - New version of OMI formaldehyde data product released
Formaldehyde (HCHO) in the atmosphere stems from pollution sources and biomass burning

NLDAS Products: Users

NCAR UCAR | ClimateDataGuide

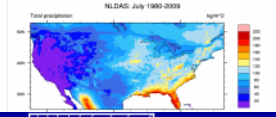
CLIMATE DATA | ANALYSIS TOOLS | MODEL EVALUATION | EXPERT CONTRIBUTORS

Climate Data

NLDAS: NORTH AMERICAN LAND DATA ASSIMILATION SYSTEM: MONTHLY CLIMATOLOGIES

Summary | Metadata | Data Access | References

NCAR/UCAR



The North American Land Data Assimilation System (NLDAS) monthly climatology data sets are broadly used by various user communities in modeling, research, and applications, such as drought and flood monitoring, watershed and water quality

CDC Home | Search | Health Topics A-Z

CDC WONDER

WONDER Home | FAQ | Help | Contact Us

North America Land Data Assimilation System (NLDAS) Daily

Request Form | Results | Map | Chart | About

Environmental Data | Dataset Documentation | Data Use Restrictions | How to Use WONDER

Centers for Disease Control and Prevention

Make all desired selections and then click any Se

1. Organize table layout:

Group Results By: Region

And By: None

And By: None

And By: None

And By: None

Select a temperature: Fahrenheit | Ce

Select Measures (Check box to include in results. Must select at least one.)

Daily Max Air Temperature (F):
Avg Temperature | # of Observations | Range

Daily Min Air Temperature (F):
Avg Temperature | # of Observations | Range

Daily Max Heat Index (F):
Avg Heat Index | # of Observations | Range

Title

National Weather Service

Climate Prediction Center

Home | Site Map | News | Organization

Search the CPC | Go

HOME > U.S. Drought > Drought Indices: Soil Moisture Percentiles

Drought Indices
- Standardized Precipitation Index (SPI)
  - Monitoring
  - Prediction
  - Verification
- Palmer Drought Severity Indices (PDSI)
- Crop Moisture Indices
- Soil Moisture Percentiles (based on NLDAS)
- Standardized

Drought Indices
Soil Moisture Percentiles

Recent Analyses

1201402

50N
45N
40N

Home
Monitoring
> Precipitation
> Temperature
> Streamflow
> Drought
Weekly Forecast
> 1-Month SPI
> 3-Month SPI
> 6-Month SPI
> Weekly Soil Moisture
> Monthly Soil Moisture
> Soil Moisture Time Series
Email me
Disclaimer
Acknowledgement
Today's Weather

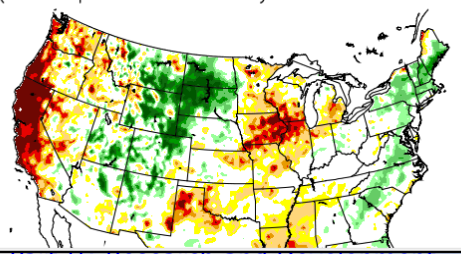
VIC Model-based Drought Condition

Move mouse over the dates on the right to see the weekly drought monitor for the last three months and the most recent forecast

Princeton University

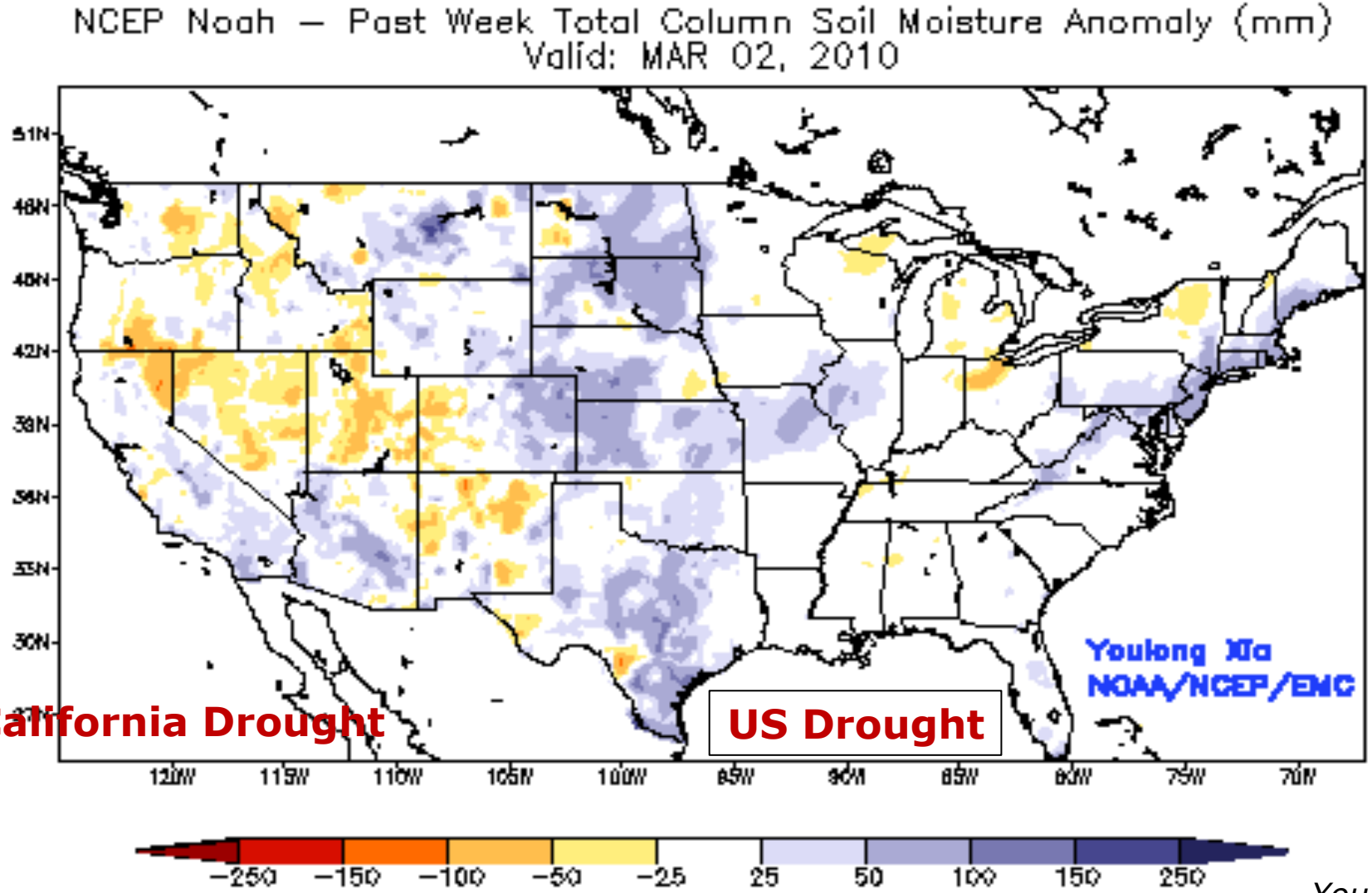
Michigan State University

Daily Soil Moisture Percentile on 20140123
(wrt samples within a 49-day window in 1979-2011)



20140123
20140130
20140206
20140213
20140220
20140227
20140306
20140313
20140320
20140327
20140403 (fcst)
20140410 (fcst)
20140417 (fcst)
20140424 (fcst)

NLDAS Products: Total Soil Column Soil Moisture Anomaly: March 2012 – December 2013



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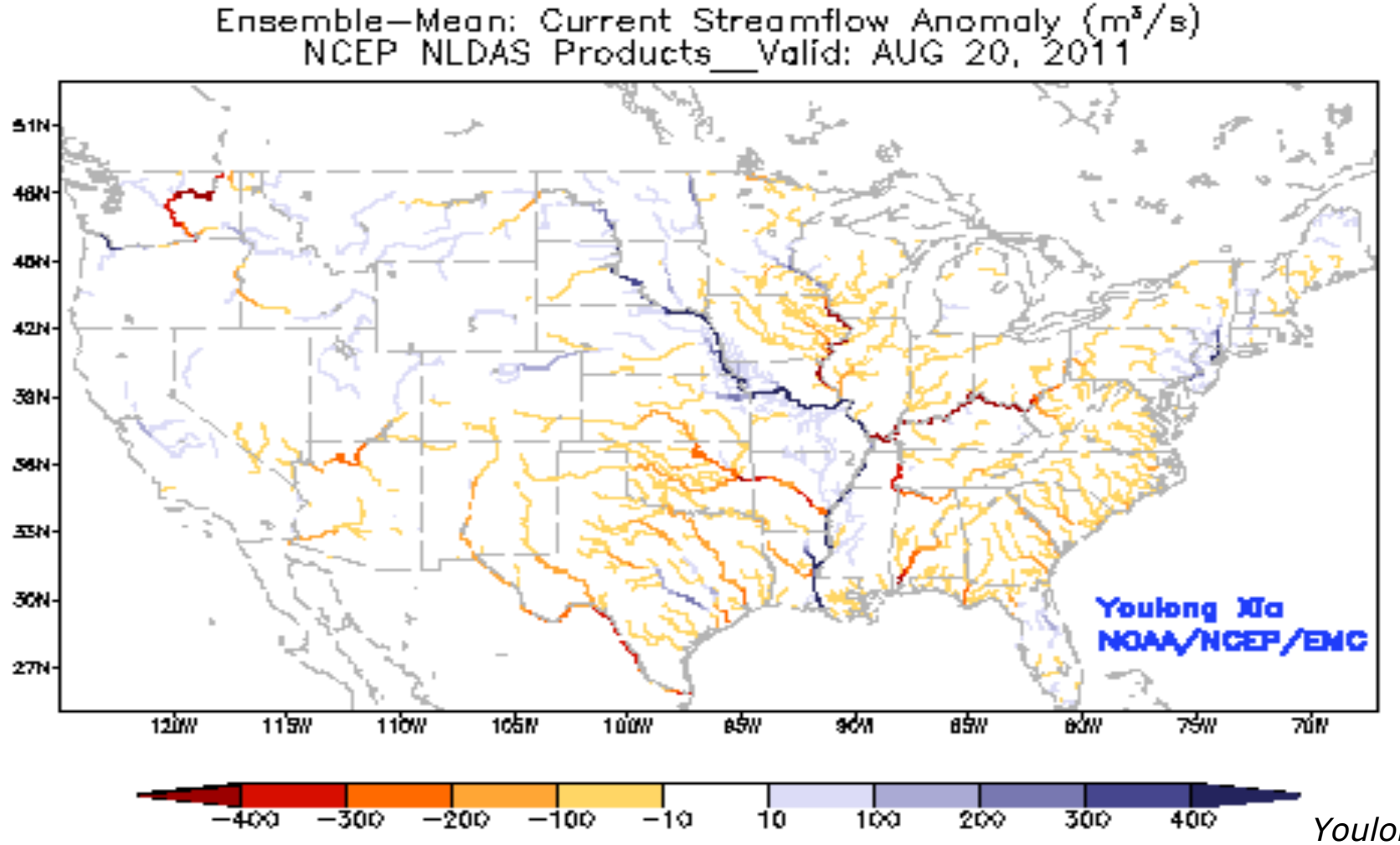
NLDAS Products: Streamflow for Hurricane Irene & Tropical Storm Lee 20 Aug – 17 Sep 2011

Ensemble mean daily streamflow anomaly (m^3/s)



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Thank you! **Future**

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Michael B. Ek: Michael.Ek@noaa,gov

- Extend the current NLDAS to run under NASA Land Information System (LIS) parallel environment, latest land model versions, assimil./validation tools.
- Improve/include:
  - Forcing, e.g. precipitation.
  - Land data sets, e.g. vegetation greenness.
  - Land data assimilation, i.e. snow, soil moisture.
  - Land model physics, to include vegetation dynamics, carbon, irrigation, etc.
  - Higher resolution/downscaling.
  - Enhance land model spin-up procedures
  - Products, e.g. "*Objective Blended NLDAS Drought Index*".
- Extend domain/resolution: first North America, then global; "merge" with CFS/GLDAS.
- Provide initial land conditions for NAM, GFS, CFS.
- Earth System modeling: Include Hydro-prediction.